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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/708,642	03/17/2004	Chih-Chung Chuang	ADTP0066USA	2641

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EXAMINER
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GEORGE, PATRICIA ANN

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 08/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/708,642

Applicant(s)

CHUANG ET AL.

Examiner

Patricia A. George

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 15 May 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-15 and 17-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 13-15, 17-20 is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission, with amendment filed on 6/15/2006 has been entered.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 1, 6, and 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hong in view of Rioux of USPN 5,554,488.

Hong et al. discloses a front end array process for making LCD panel (col.1, l.7-11), comprising: depositing a molybdenum-containing metal gate layer which consists of gate lines, gate pads, and gate electrodes that can have a single or multiple layered structure (as in applicants' claim 6, see fig. 3, 22, 24, 26 or col.10, l.55-67), and is

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deposited on a silicon substrate (fig. 2, 10 or col.1, l.34-37). Hong teaches the use of photolithography masking (ab.) followed by dry etch (i.e. uses gas mixture, col.7, l.15-45) to pattern the molybdenum-containing metal layer/s for forming both gate and data wire (i.e. word line, col. 11, l.20-25).

Hong's first embodiment teaches use of dual layers (as in applicants' claim 6) of Al-Nd and Mo-W, and it is known and preferable to use dry etch for this combination of materials (col.12, l.38-46).

Hong fails to teach substantially oblique sidewalls (as in applicants' claim 1).

Rioux teaches a conventional method of forming Mo containing (col.5, l.57) metal gate (col.5, l.49) with tapered sidewalls (i.e. oblique sidewalls), formed on the surface of a semiconductor substrate (i.e. glass; col.5, l.34-35), through use of well known photolithography and dry etch methods (col.6, l.51-59), as in claims 1, and 6.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the method of tapered sidewalls, of Rioux, when making the front end array process for making LCD panel, of Hong, because Rioux teaches it avoids undercutting, and etch damage in subsequent process (ab), an known process improvement.

As to claim 7, Hong does not specifically point out top and bottom layers, as in applicants' claim 7, but Hong's first embodiment teaches use of dual layers of Al-Nd and Mo-W (col.12, l.38-46), as in applicants' claim 7.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to form LCD panels with gate layers of dual materials, as in Hong, by selecting the order of deposition of the layers, the Aluminum containing film being first, the bottom layer, and the Moly containing film being second, the top layer, because Hong teaches the combination of materials in that specific order AL-Nd, first, then Mo-W, second.

### ***Claim Rejections - 35 USC § 103***

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hong and Rioux (see discussions above) in view of both Kim et al. (US 2003/0122987) and Przybysz et al. (USPN 4,904,980).

The combined teachings of Hong and Rioux fail to disclose that dry etch includes an over etching when etching the Mo containing metal layer, as in claim 2.

Kim et al. teaches a fabrication method for forming an array substrate of a liquid crystal display. Kim teaches the over etching of Mo is known and common in prior art (p.0027, l. 4), as in claim 2.

Przybysz et al. teaches the overetch is commonly employed during the etching of Mo because it is necessary, to allow time for the pattern to become fully defined (Description of the preferred embodiments -paragraph 4).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to combine the overetch, as taught by Kim in prior art, with the liquid crystal display invention, of Hong and Rioux, because both Kim and Przybysz

indicate it is a conventional process that will allow time for the Mo-containing pattern to become fully defined, which avoids line defects.

***Claim Rejections - 35 USC § 103***

Claims 3, 9, 10, 11, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hong and Rioux, as applied above, in further view of Hori et al. of USPN 5445710.

The combined teachings of Hong and Rioux do not disclose the specific gas mixtures or ratio of claims 3, 9, and 10-12.

Hori et al. teaches dry etching method of a substrate containing carbon; patterning the film through a resist mask; using a gas plasma; with fluorine and O<sub>2</sub> gases. Hori teaches an embodiment that includes chlorine, as well as fluorine and O<sub>2</sub> gases. Hori teaches plasma etch with the presence of carbon atoms from a film. Hori also teaches etch gases containing fluorine atoms and oxygen atoms are mixed at an atomic ratio of fluorine to oxygen to 198:1 to 1:2. Hori's ratio range encompasses the range claimed in the instant invention. In example 3, Hori used a variety of gases with oxygen (O<sub>2</sub>-col.16, l.66), including: chlorine (Cl<sub>2</sub>-col.17, l.3), fluorine (SF<sub>6</sub>-col.17, l.3), and chlorine (Cl<sub>2</sub>) and fluorine (SF<sub>6</sub>) combined (col. l.18).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to modify the LCD manufacturing method, disclosed by Hong and Rioux, by modifying the etchant gas mixtures and ratios, as taught by Hori, because Hori teaches combinations that improve the results of dry etching (col.1, l.18).

***Claim Rejections - 35 USC § 103***

Claims 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hong and Rioux, as applied above, in further view of Cheung et al. (USPN 5354417).

The combined teachings of Hong and Rioux are silent about the etching of a molybdenum-containing metal layer executed under a process pressure higher than 25 mTorr, as in claims 4.

Cheung teaches use of SF<sub>6</sub>, HBr (col. 2, l.63), and an oxygen containing gas (col.2, l.64) for an improved selective etching of a substrate (col.2, l.60) having molybdenum-containing layer (col.2, l.61). Cheung teaches the combination of Cl<sub>2</sub> and O<sub>2</sub> is typical (col.1, l.21-22) but they cause problems including “reentrant” profiles (col.1, l.29-30). Cheung teaches the process pressure at a range of 1 mTorr to 300 mTorr when etching a molybdenum-containing metal layer, which encompasses the range of higher than 25 mTorr, in claims 4.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to select an etch rate of greater than 25mTorr for etching the molybdenum-containing metal layer in the modified teachings of Hong because Cheung (5,354,417) illustrates such a pressure is effective for accomplishing the desired etch.

***Claim Rejections - 35 USC § 103***

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hong and Rioux, as applied above, in further view of Celii et al. (USPA 10/282621).

The combined teachings of Hong and Rioux are silent about the dry etch being controlled by a source power, a bias power, process pressure, oxygen flow rate and flow rate of fluorine containing gas, as in claim 5.

Celii et al. teaches an exemplary approach to plasma etching that is based on Cl<sub>2</sub> and a fluorine gas, with an oxidizer such as O<sub>2</sub>, where he controls the process temperature (para.128, l.7). Celii teaches controlling the process pressure (para. 108, l.8), the source power (para.108, l.10) , and bias power para.108, l. 10-11), as in claim 5. Celii also teaches controlling gas flow rates (see pg. 9, tables 3-5) as in claim 5.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include that dry etch is controlled by source power, a bias power, process pressure, oxygen flow rate and flow rate of fluorine containing gas, as taught by Celii, with the method for producing a liquid crystal display device that includes a matrix substrate, disclosed by Hong and Rioux, because Celii teaches alterations and modifications of various aspects will occur to others skilled in the art (para. 176, l.2-3).

### ***Claim Rejections - 35 USC § 103***

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hong and Rioux, as applied above, in further view of Nagata et al. (JP405067590A).

The combined teachings of Hong and Rioux fail to disclose the etching of the molybdenum-containing metal layer is detected by a detection method which will detect a wavelength of about 704 nm, as in claim 8.



Nagata et al. teaches the etching of a film that has a fluorocarbon with a peak of light emission in of about 700nm (ab.), which is very different than the ordinary resist wavelength of 480nm. Nagata teaches the use of a second material to conduct the etching and when the fluorocarbon film is exposed, an intensity of 704nm (ab.) is detected.

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to include the end point detection method of Nagata, in an etch used to produce a liquid crystal display device, as disclosed by the invention of Hong and Rioux, because Nagata teaches even when a stepped area exists and the etch rate is not uniform, the end point can be easily and accurately be detected.

### ***Response to Arguments***

Examiner agree with applicant's arguments, on pages 8, filed 06/15/2006, with respect to claims 13 and dependent claims 14-15 and 17-20 should be allowed.

With respect for applicants' argument on page 7, toward the reason for motivation to modify Rouix, examiner does not agree. Examiner believe that "Rioux" teaches a proper motivation in teaching a method that provides for a gate structure comprising a multilayer metal stack characterized by smoothly tapered sidewalls advantageously, avoids ion etch damage to the substrate surface surrounding the gate metal stack (ab.)

### ***Reasons for Allowance***

Claims 13- 15, and 17 - 20 allowed. The following is an examiner's statement of reasons for allowance: Closest prior art (5,554,488; 2002/0157166, and 2005/0007505 discloses etching of a molybdenum-containing metal layer using an fluorine and oxygen containing gas mixture of SF<sub>6</sub>/O<sub>2</sub>, but prior art does not disclose or suggest a front end array process for making a liquid crystal display panel, which defines a gate and word line array pattern by etching a molybdenum-containing metal layer using an fluorine and oxygen containing gas mixture of SF<sub>6</sub>/O<sub>2</sub>, at a specific ratio and flow of about 700sccm/300sccm, along with all the other limitations of claims 13 - 15 and 17 – 20. Applicant's claim Mura defects are improved by maintaining uniformity while increasing the etch rate, by raising the fluorine containing etchant, SF<sub>6</sub>, to 700sccm.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."


### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patty George whose telephone number is (571)272-5955. The examiner can normally be reached on weekdays between 7:00am and 4:30pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571)272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



PAG - 07/06

Patricia A George  
Examiner  
Art Unit 1765

NADINE NORTON  
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